E7.3 10276
CR-130559

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
3		

4. Title and Subtitle	5. Report Date
Identification of Phenological Stages & Veg. Types for Land Use Class.	Feb. 20, 1973
	6. Performing Organization Code
7. Author(s) C. Ivan Branton and J. D. McKendrick	8. Performing Organization Report No.
9. Performing Organization Name and Address Institute of Agricultural Sciences University of Alaska Box AE, Palmer, Alaska 99645	10. Work Unit No.
	11. Contract or Grant No. NAS5-21833
	13. Type of Report and Period Covered II-Semi Annual July 1972 to Jan. 1973
12. Sponsoring Agency Name and Address NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Goddard Space Flight Center Greenbelt, Maryland 20771 Technical Monitor: Mr. Edward C. Crump, Code 430	14. Sponsoring Agency Code

15. Supplementary Notes
One of 12 ERTS-1 projects conducted by the University of Alaska
ERTS-1 project, GSFC No. 110-2
Principal Investigator, GSFC ID No. UN 641

16. Abstract

Objectives of project 110-2 are to determine methods of processing ERTS-1 data products to determine vegetative associations and land forms and to relate these data to recommendations for land use. Specific responsibility for the Southern part of the 100 nautical mile transect at the 150 W meridian has been assigned to project 110-2. During this reporting period ERTS-1 imagery from both the Matanuska and Susitna valleys were studied.

Seventy millimeter ERTS-1 positives have been arrayed in a color-additive viewer (CAV) to produce images in both natural color and color infra-red. Photo enlargements in black & white and in color produced by project 110-1 personnel have been studied. On a one to 500,000 scale (3M) color photo of the Matanuska-Susitna valleys, the following features have been observed: lakes, rivers, swamps, tree lines and clouds. The grouping of reflectance patterns using computer printouts identifies vegetative associations and permits their accurate location.

17. Key Words (Selected by Author(s))	18. Distribution Statement
ERTS Imagery Remote Sensing Vegetation Analysis	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified		

(E73-10276) IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION Semiannual Report, Jul. 1972 - Jan. 1973 (Alaska Univ., Palmer.) 13 p HC $3.00 CSCL 08F G3/13

N73-17484
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I - INTRODUCTION

A: Scope and Purpose of Report

This report summarizes work performed and conclusions reached during the first six months of Contract No. NAS5-21833 ERTS-1 project No. 110-02, "Identification of Phenological Stages and Vegetative Types for Land Use Classification".

B: Summary of Work Accomplished to Date

The NASA Earth Observations Program mission 209 was conducted with the NASA NP3A Aircraft between July 11 and 28, 1972. P.I. C. Ivan Branton participated in the flight operations. Aircraft imagery has been received, indexed, and filed for use.

Most of the field season was spent acquiring ground-truth data in the Matanuska and Susitna valley areas.

The project has received 185 satellite scenes. These have been catalogued, indexed, and filed. Seven scenes were screened and selected for close examination, selected scenes have been analysed by projecting 70 mm positive transparencies with a color additive viewer. 3M color key enlargements have been obtained for the same scenes. Digital tapes have been received and are being studied for signatures of vegetative and related land features.

To become familiar with remote sensing techniques and to work effectively with ERTS data, our project has spent thirty-seven man days attending and participating in remote sensing schools and ERTS conference sessions.

A proposal for participation in the ERTS-B program was prepared and submitted on January 31, 1973.

II - STATUS OF PROJECT

A: Objectives

The overall objectives of the project is to locate and classify potential agricultural lands in an area subject to high developmental pressures. The scarcity of agricultural land in Alaska re-emphasizes the need to develop sound criteria for land use planning. Lands having agricultural potential must be identified within within the framework of a long range planning structure, if agriculture is to survive and prosper in Alaska.

Our immediate objectives during the reporting period has been to recognize and delineate vegetative types from ERTS data. Once major vegetative types are determined, the agricultural potential of those lands can be estimated from known vegetative associations, drainage patterns and soil types.

B: Accomplishments During the Reporting Period

1. Preliminary Invesitgations

The NASA Earth Observations Program, Mission 209, was conducted with the NASA NP-3A aircraft during July. Our project received aerial photography of some 616 miles of flight lines. Coverage was obtained in color, color infrared, multiband black and white photography and dual channel scanner imagery.

In order to obtain ground resource data during the growing season, vegetation was type mapped along two flight lines in the Palmer-Anchorage area. Records of vegetative cover were made on recently acquired (1971 and 1972) black and white photography, scale 1:12,000; purchased from a local aerial photographic firm.

2. Remote Sensing Schools

To work effectively with ERTS data, several remote sensing schools and ERTS training sessions have been attended by personnel working with project 110-02 as illustrated.

	C. I. Branton	J. D. McKendrick	P. Scorup
Purdue University 7/31 - 8/11/72 Short Course on Remote Sensing			x
Oregon State University 9/2/72 Private Session with Charles E. Poulton	x		
Fairbanks - Nov. 3, 1973 Current activities and plans of various agencies involved in the ERTS program in Alaska.	x	x	x
Fairbanks - Remote Sensing Short Course 12/13-12/15-'72		x	x
Fairbanks - Remote Sensing Short Course 12/18-12/20-'72	x	x	x
Anchorage - Remote Sensing Short Course, directed to the users of ERTS data and sponsored by the Federal-State Land Use Planning Commission 1/16&18 -'73	x		
1/17 - '73			x
1/19 - '73		x	x
Anchorage - Alaska Surveying and Mapping Convention 2/8 - '73			x
2/9 - '73	x		

3. Equipment

Four important pieces of equipment have been obtained and are currently in use at the Institute of Agricultural Sciences Experimental Station in Palmer. These are a Beseler Overhead projector for viewing and studying 3M color-key transparencies; a Dietzgen Mirror Stereo-scope and K & E Aerial Film Viewer, for analyzing aerial photography; and a color additive viewer constructed by project 110-1 for projecting and enhancing 70 mm positive transparencies.

4. ERTS-B Proposal

An ERTS-B Research Proposal , "Inventorying Agricultural and Potentially Agricultural Land in Alaska Using ERTS-B MSS Data", was prepared and submitted to NASA by Dr. Jay D. McKendrick. Dr. McKendrick, a range ecologist, is the co-investigator recruited for the ERTS-1 project and has been instrumental in deriving multiband signatures from ERTS MSS data. Pete Scorup is the technician assigned to the project. He has organized and filed all the photographs and satellite imagery and performed much of the routine ongoing research activities. Both of these positions are described and budgeted in our revised ERTS-A research proposal dated December 30, 1971.

5. Application of ERTS-1 Data to Project Objectives

Initially analysis by project 110-2 was based primarily on the capabilities of a color additive viewer. ERTS scenes 1033-21020 and 1049-20505 have been photo processed by project 110-1, developing 3M color key sandwiches. Viewings from the color additive viewer and 3M color key process have identified nine major vegetation types: tidal flats, shrub/carex, mixed forest, spruce forest, low elevation grasslands, subalpine shrub, subalpine grassland, alpine tundra and agricultural crop lands. Those features are known vegetation types in the Matanuska, Knik and Susitna Valleys and were identified from NASA aerial photography and other sources of ground truth. Vegetative growth in natural plant communities blend into each other without specific boundaries and few physical features appear on ERTS-1 imagery in such a way that positive identification of ground resource information can be obtained making identification of specific vegetation types difficult.

Since photographic analysis of ERTS data appears to present a problem of locating specific identifiable features, automated processing is being emphasized to obtain the required precision. Using MSS bulk digital tapes of scene 1049-20505 computer tapes compatible to the color display unit (CDU) were generated for six CDU TV viewings by utilizing the University's IBM 360 computer and the ERTS-2 MSS program developed by Bob Porter, project 110-1.

This program initiates a separate printout for each MSS spectral band and depicts the intensity level of reflectance on a scale from 0 to 127. Reflectance levels were obtained by generating two printouts. In the first printout density levels or intensities are clustered in groups of 10's; for example, levels zero through nine print out as zeros; levels ten through nineteen as number one; etc. through the 127 reflectance levels. Alphebical designations are used for two digit figures. The second printout indicates the numerical level within the cluster (first printout). By separating the groups of 10's, using various colored pens on the first printout and then overlaying the numerical listing over the 10's listing the actual intensity level of reflectance is obtained for various physical features of the landscape.

Physical features are being identified on the digital computer printouts by comparing to NASA aerial photography, ground truth data collected during the 1972 growing season, analysis of the color additive viewer and overhead projections of the 3M color key sandwiches, as well as existing geological survey available for the area.

The digital listed area starts on Tape 2 Scan Line 405, Byte 1 and ends on Tape 4 Scan Line 917, Byte 512. An additional area on Tape 3 starts with Scan Line 918, Byte 1 and ends with Scan Line 1430, Byte 810. Reflectance patterns are being derived for vegetative types, lakes, rivers, clouds, cloud shadows and other land resources.

6. Results

Nine major vegetative types have been identified from photographic extrapolation of ERTS data, using the color additive viewer and 3M color keyed sandwiches. Specific identification at any one locality is difficult as the natural vegetative types appear to blend into each other.

Because of the difficulty in specifically locating plant communities on photographic interpretations, automated processing is being emphasized. A digital computer printout of scene 1049-20505, bounded by coordinates N 61° 45', W 149° 15'/N61° 40', W 149° 00'/N61° 20', W 149° 15'/N61° 25', W 149° 30' is being compared to ground resource information, including NASA aerial photography and filed reconnaissance gathered during the summer of 1972. Multiband reflectance values have been derived for the following vegetative types and related land resources.

Physical Feature	Reflectance Readings band 4 2.5-.6	(Scale 0-127 Dark-Light) band 5 2.6-.7	band 6 2.7-.8	band 7 2.8-1.1
Canyon mouth & valley floor of Little Susitna(cottonwood & alders)		10-15	21-33	10-19
Grassland type above timberline Little Susitna		13-18	31-47	20-27
Clouds west edge, Little Susitna		20-127	50-68	
Matanuska river above Palmer(muddy)	26-38	19-25	12-21	4-8
High Ridge Lake(clear)	16-19	8-12	6-13	1-6
Baird Lake(clear)	16-18	8-11	7-11	1-6
Long Lake(clear)	16-18	8-11	7-14	0-6

Spruce type-West edge Long Lake	16-20	11-12	22-28	13-17
Cottonwood-West edge Long Lake	17-19	11-12	22-28	
50% Birch-Spruce mixed type	18-20	10-12	21-31	10-19
Birch-Aspen mixed type	19-24	11-16	26-31	11-19
Johnson Lake	16-18	8-11	7-13	0-6
Cloud	34-120	20-123	4-100	20-39
Cloud shadow	16-19	9-12	9-17	0-9
Rabbit Slough Sedge, low shrub wet type	19-23	12-17	31-36	
Cook Inlet(Deeper water)	25-30	18-22	13-32	0-6
Mud flats	21-27	15-19	14-22	6-10
Tidal flats	20-24	14-16	21-33	10-19
Large muskeg(North edge Cook Inlet)	16-19	10-14	7-15	1-7
Gravel pit & streambed-Eklutna	21-26	11-20	14-22	5-10
Edmond's Lake(clear & deep)	18-27	10-18	7-17	1-9
Mirror Lake(clear & deep)	18-21	9-14	6-18	1-9
Birchwood airstrip	22-27	15-23	18-22	7-10
Aspen-Birch escarpment	19-21	12-13	31-35	20-22
Kings Lake(deeper water)	16-19	8-11	7-9	1-6
Kings Lake(shallow water)	16-19	10-11	12-16	6-9
Wasilla Lake	16-20	8-11	7-13	1-6
Cottonwood Lake	16-19	8-11	7-13	1-6
Finger Lake	16-20	8-12	6-13	1-6
Birch-Aspen dry escarpment at Plant Materials site	18-20	11-13	30-35	20-22
Mixture of low birch, willow & alder of Kings Lake	20		30-32	20-21
Brome field	22-25	14-28	42-45	21-29
Oats-peas-barley Vickaryous	22-26	15-22	38-41	21-23
Oats and peas	22-28		31-35	

We are examining these listings of reflectance intensities and comparing the digital data to known plant communities as mapped from ground truth surveys and identified on NASA aircraft data. Identified signatures can then be used to program the color display unit when it becomes operational. The CDU will display vegetation types in a color coded manner. Photographs of those displays will then be transferred to standard base maps.

People especially concerned with vegetative information obtained from ERTS includes the state of Alaska, which still has the authority under the statehood act to receive 90,000,000 acres; Alaska Native Associations, who must make their selections under the "Native Claims Settlement Act" within a period of months; the State Division of Lands, which manages and determines the disposition of state lands; borough governments, which also assess taxes, manages, and determine the disposition of large blocks of land; and a joint federal-state land use planning commission, which is charged with the responsibility of producing recommendations for land utilization in Alaska.

III NEW TECHNOLOGY

None

IV PLANS FOR NEXT REPORTING PERIOD

A: February - March Bi-monthly Period

We will continue to derive signatures for various vegetative types and land forms. These signatures will be used to program more refined computer printouts as well as vegetative distribution patterns on the CDU when the CDU becomes operational. Classification of physical features can be accomplished by not only specifying reflectance levels for two or more bands; but also using interband ratios, and or differences. Photographs of the CDU displays will be compared to color additive viewer (CAV) projections and vegetative information extrapolated to larger areas adjacent to those studied with the computer technique.

In addition we will prepare mosaics by photographing projections on the CAV and CDU. The exposed film will be sent to project 1 for processing. Color transparencies will be scaled and overlayed on standard base maps.

B: February through July Six Month Period

Automated processing techniques will be used to derive specific vegetative information within certain sections of each ERTS scene. Vegetative types will then be extrapolated for the entire scene by photographic analysis. Color transparencies will be overlayed on standard base maps. Acreages for delineated vegetative types will be computed and compiled.

Ground truth activities will be conducted during the growing season using ERTS data displays for planning activities. Flights will be flown with small aircraft and the vegetative associations of sample areas determined after examining major vegetative features on existing ERTS scenes.

V CONCLUSIONS

We have just begun to derive vegetative reflectance patterns from automated processing techniques but it appears that a great amount of detail can be delineated by this process -- for instance, silty water is differentiated from clear lakes, shallow waters from deeper waters, and tidal flat vegetation from muskegs. Clouds and cloud shadows and narrow bands of birch-aspen stands have been plotted. Furthermore, the computer printouts provide an accurate means for calculating areas of designated features.

The work conducted so far indicates that the color additive means of analysis requires supplemental support by digital methods to gain specific information at any one location.

By comparing digitally listed areas to CAV projections, vegetative types can be extrapolated by photographic analysis.

VI RECOMMENDATIONS

Since we are emphasizing digital processing we hope the CDU soon becomes operational. We also recommend that our project take stereo photographic pairs from low flying aircraft when acquiring ground truth data.

VII PUBLICATIONS

None

VIII REFERENCES

None

APPENDIX A - CHANGE IN STANDING ORDER FORMS

No change

APPENDIX B - ERTS DATA REQUEST FORMS

Computer compatible 9-track bulk digital tape has been requested for the following scenes:

1049-20512

1066-20453

1103-20520

1104-20565

APPENDIX C - ERTS IMAGE DESCRIPTOR FORMS

An index has been compiled and image descriptor forms completed for about half the 185 satellite scenes currently on file at Palmer. Image descriptor forms are being completed only for selected scenes which will be of value to our project. Those completed are attached:

APPENDIX C

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE January 4

PRINCIPAL INVESTIGATOR C. Ivan Branton

GSFC UN 641

ORGANIZATION University of Alaska 110-02

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS* River	Glacier	Lake	Mtn.	DESCRIPTORS
1010-20324 R	x		x	x	Hiway; Agriculture
1010-20325 M	x		x	x	Hiway; Agriculture
1010-20331 X	x	x	x	x	Snow
1010-20333 1 & 2	x	x	x	x	Hiway
1010-20333 3		x	x	x	
1010-20334 M	x	x	x	x	Hiway
1013-20491 M	x		x		Braided Stream
1017-21115 4 & 5, 6 & 7	x		x	x	Forest Fire Damage
1028-20331 M	x	x	x	x	Hiway, Tundra
1029-20381 M	x		x	x	Braided Stream
1029-20383 M	x	x	x	x	Hiway, Agriculture Dust Storm
1029-20390 M	x	x	x	x	Hiway
1029-20392 4 & 5	x	x	x	x	Hiway
1029-20392 6 & 7	x	x	x	x	
1030-20433 M	x		x	x	Braided Stream
1030-20435 M	x		x	x	
1030-20442 M	x	x	x	x	Hiway, Agriculture Airfield, City
1033-21011 M	x		x		
1033-21013 M	x	x	x	x	
1033-21020 M	x	x	x	x	Snow
1036-21175 M	x		x	x	Forest Fire Damage
1037-21234 M	x		x	x	Forest Fire Damage
1046-20325 M	x	x	x		Hiway, Agriculture
1047-20390 4 & 5	x	x	x	x	Hiway, City
1047-20390 6 & 7	x	x	x	x	
1048-20433 M	x		x	x	Braided Stream
1048-20435 M	x				Braided Stream
1049-20505 4 & 5	x	x	x	x	Hiway, City, Inlet, Fault

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

MAIL TO ERTS USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

GSFC 37-2 (7/72)

APPENDIX C

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY

D ____

N ____

ID ____

DATE ____

PRINCIPAL INVESTIGATOR C. Ivan Branton

GSFC ____

ORGANIZATION University of Alaska 110-02

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*				DESCRIPTORS
	River	Glacier	Lake	Mtn.	
1049-20505 6 & 7	x	x	x	x	Inlet, Fault
1049-20512 M	x	x	x	x	Inlet, Snow Island
1050-20550 M	x		x		Braided Stream
1050-20555 M	x		x	x	

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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CODE 563
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301-982-5406

GSFC 37-2 (7/72)

APPENDIX D - SIGNIFICANT RESULTS

THIRD BI-MONTHLY PROGRESS REPORT
UNIVERSITY OF ALASKA
ERTS PROJECT 110-2
February 20, 1973

PRINCIPAL INVESTIGATOR: C. Ivan Branton
TITLE OF INVESTIGATION: Identification of Phenological Stages and Vegetative Types for Land Use Classification
SUBDISCIPLINE: Agriculture/Forestry/Range Resources
SUMMARY OF SIGNIFICANT RESULTS:

ERTS-1 scenes 1033-21020 and 1049-20505 have been photo processed by personnel of project 110-1, developing 3M color key sandwiches. Viewings from the color additive viewer and 3M color key process have identified nine major vegetation types: tidal flats, shrub-carex, mixed forest, spruce forest, low elevation grasslands, subalpine shrub, subalpine grassland, alpine tundra and agricultural crop lands. Those features are known vegetation types in the Matanuska, Knik and Susitna Valleys and were identified from NASA aerial photography and other sources of ground truth. Specific identification at any one locality is difficult because the growth pattern of the natural vegetative types blend into each other. Pure stands are infrequent.

Since photographic analysis of ERTS 1 data appears to be limited because of this characteristic, automated processing is being emphasized. Using MSS bulk digital tapes of scene 1049-20505, computer tapes compatible to the color display unit (CDU) were generated for six CDU TV viewings by utilizing the University's IBM 360 computer and the ERTS 1 MSS program developed by Bob Porter, project 110-1.

A digital computer printout of scene 1049-20505, bounded by coordinates N 61° 45', W 149° 15'/ N 61° 40', W 149° 00'/ N 61° 20', W 149° 15'/ N 61° 25', W 149° 30' is being compared to ground resources information, including NASA aerial photography and field reconnaissance information gathered during the summer of 1972. Multiband reflectance patterns have been derived for several vegetative types and related land resources.

We are examining listings of reflectance intensities and comparing the digital data to known plant communities as mapped from ground truth surveys and identified on NASA aircraft data. Identified signatures can then be used to program the CDU when it becomes operational. A great deal of detail can be delineated by this process -- for instance, silty water is differentiated from clear lakes, shallow waters from deeper waters, and tidal flat vegetation from muskegs. Clouds and cloud shadows and narrow bands of birch-aspen stands have been plotted. Furthermore, the computer printouts provide an accurate means for calculating specific locations and areas of designated features.